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Nationalizing provincial weather: meteorology in nineteenth-century Cornwall

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Abstract. This paper examines the development of a quantified, standardized and institutionalized meteorological science in nineteenth-century Britain, one that relied on sophisticated instrumentation and highly regulated observers and techniques of observation in its attempt to produce an accurate picture of the national weather. The story is told from one of the numerous points in British meteorology's extensive collection network: from Cornwall, in the far southwest of England. Although the county had been an acknowledged centre of meteorological labour since the eighteenth century, it came increasingly under the influence of various London-based meteorological institutions in the 1830s and in 1868 was chosen as the site of one of the Royal Society of London's few prestigious 'first-order' meteorological observatories. This case study presents us with the opportunity to witness the ways in which a national scientific enterprise was assimilated and interpreted in a particular local context. It gives us a chance to see how regulated forms of instrumentation and quantified measurement were translated in a particular place and, of course, how the non-place-bound ideals of metropolitan science occasionally faltered in the face of local values and preoccupations.

Spaces of science

> One important meaning of the scientific ideal is an aspiration to escape the bounds of locality and culture.[1] T. M. Porter

There has emerged over recent years a significant corpus of literature that has demonstrated the profoundly spatial nature of the scientific enterprise.[2] Far from agreeing with science's sense of itself as becoming increasingly free from the subjectivities of society and space, a sentiment expressed by Porter, above, this work has sought to expose

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1 T. M. Porter, 'Making things quantitative', *Science in Context* (1993), **7**, 389–407, 389.

2 For two recent commentaries see D. N. Livingstone, 'Text, talk and testimony: geographical reflections on scientific habits', *BJHS* (2005), **38**, 93–100; S. Naylor, 'Historical geographies of science: places, contexts, cartographies', *BJHS* (2005), **38**, 1–12.

science as something utterly grounded in its social and spatial – not to mention temporal, political and economic – contexts. This is not to say that science does not have a remarkable capacity, let alone desire, to reach across space and so to seem at times to be universal in its extent. It is instead to suggest, following the work of Bruno Latour and others, that the power of science is due not so much to an unmediated access to the truth as to an unprecedented control over space.[3] For Latour, science is a form of knowing and acting at a distance, where there are increasingly tightly woven relations between a centre – his 'centre of calculation' – and myriad distant places and objects. As Andrew Barry has put it, the 'power of a scientific argument or a measurement is not determined by its truth, but rather judged in terms of its capacity to act across space and time – to mobilize a network of social and technical actors'.[4]

This is not to say that science labours to project itself as some sort of 'ordered totality' over society and space. It operates rather 'in terms of more localized entities' where the aim is to reproduce itself across these myriad points in its network.[5] In other words, science extends itself out from a single point by replicating itself in other places. The success of science depends entirely on its ability to ensure that procedures and findings from one place can be produced elsewhere. This is of course much less simple than it sounds and requires no less than the establishment of precision, the replication of instrumentation, the regulation of techniques of observation, and the standardization of measurement and experimentation. Jan Golinski, for instance, traces the development of instruments from objects of investigation in themselves to tools that can be taken for granted and 'employed together with other instruments in complex systems that configure objects so as to make them available for observation and manipulation'.[6] In turn, the information that instruments help collect has to be performed in an accepted, standardized form, so that one data-set can be compared to another from a different locality – so that, in short, knowledge can circulate more freely. Barry argues that 'effective long-distance communication required both measurement of the properties of objects, and the management and training of operatives and engineers who could be relied upon to carry out their work at a long distance from the centre',[7] while David Livingstone notes that scientific centres of calculation could 'operate with any conviction only if the data they manipulated had been obtained in some systematic way'.[8] Porter points to the significance of quantification as key to the movement of knowledge, as it 'promotes the fixing of conventions, the creation of stable entities that can be deployed across great distances'.[9]

Perhaps the best example of this fixing of conventions was the invention of the metrological tradition in the immediate aftermath of the Napoleonic Wars. Metrology was the 'construction of reliable common standards of measurement' that were

3 B. Latour, *Science in Action*, Harvard, 1987.

4 A. Barry, 'The history of measurement and the engineers of space', *BJHS* (1993), **26**, 459–68, 459.

5 Barry, op. cit. (4), 462.

6 J. Golinksi, *Making Natural Knowledge: Constructivism and the History of Science*, Cambridge, 1998, 134.

7 Barry, op. cit. (4), 466.

8 D. N. Livingstone, *Putting Science in Its Place: Geographies of Scientific Knowledge*, Chicago, 2003, 175.

9 Porter, op. cit. (1), 389.

'supposed to allow science more effortlessly to escape the trammels of interest and judgement'.[10] This so-called Second Scientific Revolution of the early nineteenth century promoted the standardization of information, where inspection and tabulation became symbols of scientific control and associated with sober evaluation and moral purity.[11] The success of this project is evidenced in what Ian Hacking has termed the 'avalanche of printed numbers' in the first quarter of the nineteenth century.[12] But of course even metrology, perhaps the ultimate example of the attempt to create universal values, was not removed from local circumstance. Simon Schaffer notes that 'the issue of place was crucial' in the determination of metrological standards.[13] Where was the best location for a standards site? Where should standards trials be performed? How should standards be carried out into the wider world? How should society deal with the co-presence of contradictory standards, as was the case with the British imperial yard and the French republican metre? And what about dealing with the inadvertent destruction of standards? When, for instance, Britain's Houses of Parliament burnt down in 1834 they took with them the nation's standards of length and weight.[14]

Questions such as these effectively highlight the very local nature of measurement, a factor most obvious when things go awry. Indeed, and as the Treasury workmen who caused the fire in the Houses of Parliament would have been uncomfortably aware,

> there is a need to recognize that the history of measurement must be understood as equally a history of the failures of measurement; a history of the phenomena which remain unmeasurable; a history of the incompetencies, and passive resistances of scientists and lay people to the exacting requirements of measurement techniques; a history also of the degree to which the attempts to measure have failed to meet the economic, political and moral demands to which they have been tied.[15]

Buildings burn down, instruments malfunction, observers get tired, sick or just careless and suddenly universality falters and the local is apparent again. Indeed, it is often when things do not work as they should that we can see the operations of science most clearly – as a form of local craft knowledge that works by persuading other people in other places to organize their practices in an identical fashion. As Livingstone so succinctly puts it, 'What looks like the universalism of science – its seemingly problem-free transferability from one arena to another – turns out to have much to do with the replicating, standardizing, or customizing of local procedure'.[16]

This paper traces an attempt to extend a scientific culture across a national area. In particular it examines the development of a quantified, standardized and institutionalized meteorological science in nineteenth-century Britain, one that relied on sophisticated instrumentation and on highly regulated observers and techniques of

10 S. Schaffer, 'Metrology, metrication, and Victorian values', in *Victorian Science in Context* (ed. B. Lightman), Chicago, 1997, 440.

11 Schaffer, op. cit. (10), 441.

12 I. Hacking, *The Taming of Chance*, Cambridge, 1992, p. vii.

13 Schaffer, op. cit. (10), 444.

14 Schaffer, op. cit. (10), 444.

15 Barry op. cit. (4), 468.

16 Livingstone, op. cit. (8), 142.

observation in its attempt to produce an accurate picture of the national weather. However, the story is told not from the standpoint of the metropolitan centre, whence standards and procedures were set, but from one of the numerous points in British meteorology's extensive network of collection points: Cornwall. England's most south-westerly county is interesting for a number of reasons. Whilst it was geographically isolated from the rest of the country until the eventual extension of the Great Western Railway to Penzance in the 1860s, Cornwall was nonetheless central to various economic, political and intellectual activities and debates. It was one of the earliest areas to industrialize in Britain; it enjoyed access to international networks through the operations of the Falmouth Packet Service; it held disproportionate parliamentary influence; it fostered a flourishing scientific culture that produced the likes of William Borlase, Humphry Davy and Davies Gilbert; and it harboured an enduring regional identity that found its source in all these arenas. This paper evaluates Cornwall's contributions to the burgeoning science of meteorology and the county's participation in several significant periods of restructuring meteorological practice and administration over the course of the nineteenth century.

The paper begins in the eighteenth century with the labours of Cornwall's 'meteoric' weather observers. The aim here is not so much to give a detailed history of this period as to provide a context for the prejudices of later meteorologists. The paper next considers meteorology's shift from a descriptive art to an instrumental science in the early nineteenth century and then to the standardization and institutionalization of meteorology in the mid-nineteenth century: the ways in which bodies such as the Royal Society and the Meteorological Office impacted upon weather-collecting in Cornwall. The later sections of the paper consider the development of a national weather-collecting culture, one built around a small number of technologically advanced 'laboratories' of weather observation. The paper focuses on the establishment of a Royal Society 'first-order' meteorological observatory in Falmouth in 1868, the Royal Society's attempt to close it in 1883, and its reconstruction in 1885. This geographical focus enables us to witness the ways in which a national scientific enterprise was, echoing Golinski, assimilated and interpreted in a particular local context.[17] We see how regulated forms of instrumentation and quantified measurement were translated in a particular place, and, of course, how the non-place-bound ideals of metropolitan science occasionally faltered – sometimes dramatically but more often in small and more mundane ways – in the face of local values and preoccupations.

By tracing the fortunes of Cornish meteorology from the mid-eighteenth to the end of the nineteenth century we are also able to consider a profound shift in the epistemic geographies of natural knowledges. In his own study of eighteenth-century meteorology, Vladimir Janković points to the changing status of 'the meaning of locality'. The significance of place in meteorological enquiry shifted 'from its status as an exclusive end of investigation to a specimen in a larger entity, a point on a grid'.[18] By concentrating on one regional meteorological culture we are able to observe the

17 Golinski, op. cit. (6), 138–9.

18 V. Janković, *Reading the Skies: A Cultural History of English Weather, 1650–1820*, Manchester, 2000, 11.

local manifestations of these powerful new 'practices of place', and at a variety of scales, too – from philosophical approaches, to institutional arrangements, down even to the bodies of observers themselves.[19]

Quantifying Enlightenment weather

Eighteenth-century meteorology was a highly localized and idiosyncratic activity. Meteorology was generally the preserve of the provincial natural historian who took it upon himself to provide detailed descriptive accounts of his own locality, whether pertaining to botany, antiquities or weather events. Meteorological accounts took the form of calendars, diaries and narratives and they tended to concentrate on singular extraordinary events, such as freak or extreme weather – what has been termed the 'meteoric tradition'.[20] However, this did change in the latter half of the eighteenth century with increasing numbers of naturalists beginning to move away from the meteoric tradition and starting to accumulate 'instrumental weather records' – in other words, the daily measurement of atmospheric variables.[21] Eighteenth-century Cornish meteorology exemplified these characteristics, embodied in the work of the Reverend William Borlase. Borlase was a Cornishman by birth, and after gaining his MA from Oxford in 1719 and his ordination in 1720 he returned to assume the rectorate at Ludgvan, in west Cornwall.[22] He became well known for his studies of Cornish natural history and antiquities and was acknowledged as a national authority on the weather.[23] From the 1750s to the 1770s Borlase published a number of papers on Cornish weather in the *Philosophical Transactions* of the Royal Society, of which he was a Fellow. His work conformed to the earlier meteoric tradition and many of his papers focused on particular meteoric events, such as one on the effects of lightning strikes on a house in the village of Gulval in 1752. Borlase also kept daily records of the weather and had no difficulty in reconciling the importance of isolated reports and synoptic monitoring.[24] Several other registers of Cornish weather were kept over the same period, by Mr Gregor of Trewarthenick, east of Truro, from 1765 to 1782, and by a Mr James of Redruth, from 1787 to 1806. Whilst the validity of this form of weather-collecting was based on the routinization of recordings, the natures of those recordings were still highly individualized, in terms of both the types of observation made and their timing.

The early years of the nineteenth century were witness to frenetic attempts to standardize information about both the natural and social worlds – the so-called

19 On practices of place see R. Kohler, 'Place and practice in field biology', *History of Science* (2002), **40**, 192.

20 Janković, op. cit. (18); J. Golinski, '"Exquisite atmography": theories of the world and experiences of the weather in a diary of 1703', *BJHS* (2001), **34**, 149–71.

21 Janković, op. cit. (18). See also J. Golinski, 'Barometers of change: meteorological instruments as machines of Enlightenment', in *The Sciences in Enlightened Europe* (ed. William Clark, Jan Golinski and Simon Schaffer), Chicago, 1999, 69–93.

22 P. A. S. Pool, *William Borlase*, Truro, 1987.

23 V. Janković, 'The place of nature and the nature of place: the chorographic challenge to the history of British provincial science', *History of Science* (2000), **38**, 79–113.

24 Janković, op. cit. (18), 111.

Second Scientific Revolution. In Britain alone a number of acts and inspectorates were established through the 1820s, 1830s and 1840s that required the quantification and standardization of data, for instance the Weights and Measures Act of 1824, the Statistical Department of the Board of Trade (1832), the Factory Inspectorate (1833), the Registrar-General (1837), the Observatory of the British Association of the Advancement of Science (hereafter BAAS) at Kew (1842) and the Excise Laboratory (1842).[25] This impulse was just as relevant to the development of meteorology. Janković argues that the early nineteenth century marked a shift away from the provincial meteoric tradition with its descriptive and idiosyncratic reports of extraordinary atmospheric events, and towards a collecting endeavour based on standardization, quantification and synchronization. The qualifications required of the meteorologist also shifted from the place-based experience and authority of the provincial cleric–naturalist to the expertise-based metropolitan specialist, who gave little regard to local information. Influential metropolitan chemists and physicists, Janković claims, argued for a removal 'of meteorological practice from places of life to places on the map'.[26] Standardized means of measuring the weather increasingly conquered various local practices (though of course such procedures really amounted to the triumph of one set of local practices over others) so that atmospheric data from locations across the country could be assembled in central offices.[27] This shift in practice from qualitative description to instrumental measurement was certainly reflected in the practice of Cornish meteorology in the first half of the nineteenth century.

A number of meteorological records were begun in the county in the 1820s and 1830s, some lasting only a few years, others running over almost a lifetime. The observations of Jonathan Couch at Polperro, Mr Corbett at Pencarrow, Mr Moleworth at St Breoke and Mr Johns on the Isles of Scilly fell into the former, whilst those of Lovell Squire, Matthew Paul Moyle and Commander Liddell, the latter. Moyle, a surgeon and meteorologist of some note, kept registers of the weather at Helston from at least 1821 to 1879, publishing early accounts of the weather there in *Thomson's Annals of Philosophy*,[28] along with more general discussions of meteorological instruments and the 'atmosphere' of mines.[29] He also later published yearly summaries of Helston's weather in the *Reports* of the Royal Cornwall Polytechnic Society (hereafter RCPS) from 1841 to 1879. Commander Liddell kept records in Bodmin from 1850 to 1880 whilst Lovell Squire did the same from his house in Falmouth from at least 1835 to 1856. Both men, like Moyle, published yearly summaries of their records in the *Reports*

25 M. J. Cullen, *The Statistical Movement in Early Victorian Britain: The Foundations of Empirical Social Research*, Sussex, 1975; I. Hacking, op. cit. (12); Schaffer, op. cit. (10).

26 Janković, op. cit. (18), 159.

27 Livingstone, op. cit. (8), 177.

28 M. P. Moyle, 'Meteorological journal kept at Helston, Cornwall, for 1821', *T. Thomson's Annals of Philosophy* (1822), **3**, 190–4.

29 M. P. Moyle, 'On the height of the barometer', *T. Thomson's Annals of Philosophy* (1823), **5**, 376–8; *idem*, 'On an improvement of the clinometer', *T. Thomson's Annals of Philosophy* (1825), **7**, 122; *idem*, 'On the temperature of the Cornish Mines', *Transactions of the Royal Geological Society of Cornwall* (1822), **2**, 404–15; *idem*, 'On the temperature of mines', *T. Thomson's Annals of Philosophy* (1823), **5**, 34–9; *idem*, 'On the atmosphere of Cornish mines', *Report of the RCPS* (1839), 74–95 and (1840), 37–48.

of the RCPS and Squire went on to become the society's first paid meteorological observer upon the establishment of a meteorological observatory in Falmouth in 1868.

These early nineteenth-century records of Cornish weather were certainly quite different from those eighteenth-century accounts that provided detailed descriptions of individual events. These were quantified reports of the weather, rendered in the form of tables of averages. But although the reports had a superficial resemblance when placed on consecutive pages of the yearly reports of a local scientific society, they were actually by no means standardized accounts. For instance, Squire's early registers contained daily weather information, including maximum and minimum temperatures, quantity of rain, direction of wind and the height of the barometer in the morning and evening.[30] Meanwhile, Jonathan Couch's registers were in the form of monthly accounts and contained maximum and minimum temperatures, and then only more qualitative information on weather type. He recorded that the 'Thermometer was hung in a shady room', and that from 1821 to 1828 temperature was noted at 1 p.m. and after 1828 at 9 a.m., 'at which time it is presumed to mark the average of the day'.[31] In turn, Mr Corbett's register of the weather at Pencarrow, Wadebridge, contained monthly mean maximum and minimum temperature, monthly barometric averages, 'Average Degree of Dryness' – taken at 1 p.m. – and 'Average Quantity of water held in solution by the atmosphere'. Instruments were kept on a small table in the centre of Corbett's garden, and observations made at seven o'clock every morning.[32]

This instrumental meteorology remained highly localized, the character of the investigation entirely dependent on 'the observations of the vulgar', as the Royal Institution chemist John Frederic Daniell put it in 1823.[33] These observers, according to metropolitan doyens like Daniell, lacked discipline, geared the timing of their observations by the routine of their day, used unreliable instruments, were unable to employ them to best effect and were generally unaware of the latest developments in the field. In other words, whilst provincial meteorology had shed its obsession with isolated extreme events, its tabulation, reduction and calculation of averages of localized weather by highly idiosyncratic recording methods hardly warranted a proper science of weather.[34] The provincial meteorology that Daniell and others decried – the weather collecting of the likes of Corbett, Couch and Squire – was a subjective and situated meteorology performed by vulgar individuals who lived firmly within (rather than sustaining an objective distance from) the weather, and was not so different from, certainly not much more use than, the work of their eighteenth-century forebears.

Weather-collecting institutionalized

The 1840s and 1850s were important times for British meteorology. The Meteorological Department of the Board of Trade was formed in 1854 under the stewardship

30 See, for instance, L. Squire, 'Meteorological Register', *Report of the RCPS* (1836), 60–1.
31 J. Couch, 'Tables of the thermometer and weather', *Report of the RCPS* (1836), 66.
32 Mr Corbett, 'Observations made at Pencarrow', *Report of the RCPS* (1841), 141.
33 Quoted in Janković, op. cit. (18), 162.
34 Janković, op. cit. (18), 163.

of Captain Robert FitzRoy. This government department was tasked with providing information on marine meteorology for use by shipping – one of many instances in mid-century where measurement was being employed in the regulation of space for empire, industry and government.[35] The Meteorological Department was aided by the Kew Committee of the BAAS, who tested and standardized their instruments at their Kew Royal Observatory at Richmond, west London (acquired by the British Association in 1841). The British (later Royal) Meteorological Society was formed in 1850. James Glaisher, the superintendent of the Magnetic and Meteorological Department of the Greenwich Royal Observatory since 1840, was the driving force behind the society and became its secretary.[36] The Scottish Meteorological Office was formed in 1856.[37] Both the British Association and the British Meteorological Society placed great emphasis on instrumentation, precision, rigorous numerical analysis and accurate record-keeping, unsurprising given their intimate associations with two leading centres of metrology in Britain: the Kew and Richmond observatories.[38]

The influence of these societies quickly fed down to the practice of meteorology in the provinces, and in Cornwall was channelled primarily through the county's own scientific societies. The Royal Institution of Cornwall (hereafter the RIC), formed in 1818 and based in Truro, and the RCPS, formed in 1833 and based in Falmouth, were the most important of the county's numerous societies in the furtherance of Cornish meteorology.[39] The RCPS had developed tabular forms for the registration of daily observations and graduated diagrams for the representation of monthly results as early as 1840, which were distributed to individuals willing to collect readings for the society, even though many of their observers, some mentioned earlier, failed to use them. These forms were modelled on meteorological guidance given in a pamphlet produced by the Royal Society in 1838 that asserted 'the paramount advantages of conformity by all, to one and the same method'.[40] The society also secured a standard barometer and thermometer for use at Falmouth, although their 'limited means' prevented them from doing any more, or indeed from following exactly the collection guidelines set out by the Royal Society.[41] Despite the RCPS's wish to gather observations from stations across the county – 'to embrace all the chief peculiarities of situation' – their increasingly stringent measures quickly reduced the number of individuals willing to take measurements, so that by the mid-1840s the only stations regularly supplying data were those managed by Squire in Falmouth, Moyle in Helston and the RIC in Truro.

35 Barry, op. cit. (4), 467.

36 On the Royal Meteorological Society see Malcolm Walker, 'The Royal Meteorological Society as seen through its membership', *Weather* (2000), **55**, 104–8; for a longer history of meteorological societies in England see J. M. Walker, 'The meteorological societies of London', *Weather* (1993), **48**, 364–72.

37 J. Burton, 'Robert FitzRoy and the early history of the Meteorological Office', *BJHS* (1986), **19**, 147–76.

38 Schaffer, op. cit. (10), 445.

39 On the history of Cornwall's scientific institutions see S. Naylor, 'The field, the museum, and the lecture hall: the spaces of natural history in Victorian Cornwall', *Transactions of the Institute of British Geographers* (2002), **27**, 494–513; F. A. Turk, 'Natural history studies in Cornwall (1700–1900)', *Journal of the Royal Institution of Cornwall* (1959), 229–79.

40 Anon., 'Meteorological report', *Report of the RCPS* (1842), 23.

41 Anon., op. cit. (40), 24.

The RIC, like its Falmouth counterpart, had been collecting weather data since the late 1830s. It came under the influence of various national bodies in 1845 when it began relaying its observations of Truro's weather to the British Agricultural Society and to William Farr of the Registrar General's office. Farr, who was made FRS in 1855, used the RIC's data in his well-known work on medical topography and public health.[42] The RIC's work also came under the attention of the Magnetic and Meteorological Observatory at Greenwich through that body's involvement in Farr's work,[43] and the RIC, acutely aware of the increased visibility of their observations, decided to invest in better instruments: a standard barometer in 1851 and a Negretti and Zambra thermometer in 1856. James Glaisher of the Royal Observatory agreed to test and calibrate the instruments prior to use, thus providing 'further security for accuracy of results'.[44] In 1857 new daily meteorological observation forms were instituted 'with the view of still more perfect conformity with the system established and superintended by the officers of the Royal Observatory', paid for jointly by the RIC and the RCPS. The two societies' involvement with Glaisher meant that they became known to the British Meteorological Society, of which Glaisher was the secretary.[45]

The weather records produced by the RIC and by observers for the RCPS became largely standardized by the 1860s. Observations of the wet and dry thermometers, of the degree of cloudiness, of barometric pressure and wind speed and direction were all taken at Truro, Helston and Falmouth at the same times: at 9 a.m., 3 p.m. and 9 p.m. Other measures such as humidity were also standardized, whilst more qualitative information on phenological and particular weather events – lightning seen, frosts, gales and so on – was recorded in an identical fashion at each station. Monthly averages of these readings were then produced, presented and printed on uniform forms in the RIC *Journal* and RCPS *Reports* (Figure 1). Through notes accompanying the tables, local observers were also keen to establish the careful and accurate nature of the records and the high scientific standards upon which they were made. For instance, Matthew Moyle reported that his rain gauge 'was on Howard's principle, 5 feet from the surface of the ground, and perfectly free from any local effects'. He also noted that information on humidity, dew point and weight of vapour was deduced from Greenwich Meteorological Observations (even if these dated from 1847); that corrections to the diurnal ranges of barometer and thermometers were from Glaisher's tables; and that 'in all the calculations, and adjustments of the instruments, a strict adherence has been given to the directions of the Astronomer Royal and the Committee of the Royal Society'.[46]

42 For a brief history of William Farr's life see S. Sheard, 'Farr, William (1807–83)', in *The Dictionary of Nineteenth-Century British Scientists* (ed. B. Lightman), 4 Vols., Bristol, 2004, ii, 674–5.

43 Glaisher mobilized an extensive network of volunteer meteorologists around Britain who supplied him with daily weather notes, from which he compiled quarterly meteorological reports for the registrar general. C. Waff, 'Glaisher, James (1809–1903)', in *The Dictionary of Nineteenth-Century British Scientists* (ed. B. Lightman), 4 vols., Bristol, 2004, ii, 788–9.

44 Anon., 'Thirty-eighth annual report, 1856', *Report of the Royal Institution of Cornwall* (1857), 11.

45 Anon., 'Report of the Council', *Report of the Royal Institution of Cornwall* (1865), p. xi.

46 M. P. Moyle, 'Meteorological summary of the weather at Helston, in Lat. 50° 7′ N., and 5° 18′ W., for the year 1864', *Report of the RCPS* (1865), unpaginated.

Summary of Meteorological Observations at Truro, in Lat. 50° 17′ N., Long. 5° 4′ W., for the year 1864, from Registers kept at the Royal Institution of Cornwall.

TABLE No. 1.

1864.	MONTHLY MEANS OF THE BAROMETER. Cistern 43 feet above mean sea level.																
Month.	Mean pressure corrected to 32 deg. Fahr.			Mean of monthly means.	Mean correction for diurnal range.	True mean of monthly means.	Mean force of vapour.	Mean pressure of dry air.	Corrected absolute maximum observed.	Day.	Corrected absolute minimum observed.	Day.	Extreme range for the month.	Mean diurnal range.	Greatest range from 9 a.m. to 9 p.m.	Day.	Greatest range in any consecutive 24 hours	Between which days it occurred.
	9 a.m.	3 p.m.	9 p.m.															
	in.	in.	in.	in.	in.	in.	in.	in.	in.		in.		in.	in.	in.		in.	
January	30·097	30·084	30·107	30·096	·004	30·092	0·247	29·845	30·442	3	29·653	9	0·789	·094	·36	1	·55	1 & 2
February	29·892	29·879	29·919	29·897	·003	29·894	0·199	29·695	30·371	5	29·151	10	1·220	·099	·52	13	·58	13 & 14
March	29·618	29·625	29·655	29·633	·007	29·626	0·253	29·373	30·281	12	28·955	7	1·326	·101	·30	9	·52	12 & 13
April	30·010	30·015	30·035	30·020	·004	30·016	0·276	29·740	30·287	8	29·657	11	1·630	·054	·13	1	·27	1 & 2
May	29·696	29·964	29·996	29·976	·002	29·974	0·340	29·634	30·185	18	29·494	8	0·691	·048	·23	10	·32	10 & 11
June	29·954	29·961	29·991	29·969	·001	29·968	0·321	29·647	30·318	19	29·634	13	0·634	·059	·22	16	·31	23 & 24
July	29·996	29·988	29·998	29·994	·002	29·992	0·399	29·593	30·196	6	29·678	2	0·518	·055	·22	3	·33	1 & 2
August	30·058	30·063	30·086	30·069	·004	30·065	0·358	29·707	30·365	14	29·660	19	0·705	·063	·24	23	·37	23 & 24
September	29·894	29·888	29·921	29·901	·004	29·897	0·421	29·476	30·298	26	29·226	16	1·072	·063	·15	20	·44	13 & 14
October	29·730	29·715	29·757	29·734	·006	29·728	0·322	29·406	30·357	17	28·677	22	1·680	·085	·24	22	·53	19 & 20
November	29·726	29·713	29·756	29·732	·004	29·728	0·265	29·463	30·619	6	28·727	15	1·892	·150	·53	18	·60	15 & 16
December	29·949	29·937	29·958	29·948	·003	29·945	0·215	29·730	30·483	24	29·308	13	1·175	·074	·37	20	·37	19 & 20
Means	29·885	29·902	29·932	29·914	·004	29·910	0·301	29·609										

REMARKS.—0·05 in. should be added to all the readings of the Barometer for its elevation of 43 feet above mean sea level. The Barometer is a Standard, made by Barrow, and, compared with the Standard Barometer at the Royal Observatory, Greenwich, by Mr. Glaisher. The corrections for Index Error (+ 0·008), and for Capillarity (+ 0·013), have been applied.

Figure 1. Table summarizing barometric observations at Truro for 1864, compiled from registers kept by the RIC (from the *Forty-Sixth Annual Report of the Royal Institution of Cornwall*, Truro, 1865).

Schaffer has noted that systems of standardization, distribution of instructions, division of labour and rigid hierarchical management seemed to offer the key to Victorian scientific progress.[47] So it was for mid-nineteenth-century meteorology. The quantification of the weather redefined a moral and methodological landscape for meteorological science. The 'uneducated amateurism of meteoric reportage' was jettisoned, as were the fumbling attempts at an instrumental meteorology of the 1820s and 1830s.[48] This new science of the weather demanded new meteorological subjects and objects: calibrated instruments and regulated observers. Instruments were to be free from local interference, observers to be unaffected by the demands of their daily lives, their measurements to be tabulated and presented according to standardized principles. Through this process Cornish weather-collectors were reshaped into stations on a map and Cornish weather into numbers on a page. In the process data on Cornish weather was rendered useful to metropolitan science and British industry. In terms of the latter, local meteorologists claimed that the daily and continuous observations from stations across the county proved that its climate was milder than elsewhere in Britain and so ideal for the tourist, the invalid and the farmer.[49]

47 Schaffer, op. cit. (10), 445.

48 Janković, op. cit. (18), 161.

49 See, for instance, W. P. Dymond, 'Meteorology of West Cornwall. 1870', *Reports of the RCPS* (1871), 125–8.

National weather

Robert FitzRoy had struggled in his role as head of the Board of Trade's Meteorological Department to persuade others of the value of weather forecasting. Indeed, criticisms of his work, it is presumed, played some role in precipitating his suicide in April 1865.[50] The Board of Trade subsequently instigated an investigation into the work of the department. Royal Society advice was sought and a committee established, made up of Francis Galton, Thomas Farrer and Staff Commander Frederick John Evans.[51] Its report, laid before Parliament in April 1866, was very critical of the department's statistical compilations and methods of presentation of data under FitzRoy. Forecasts were poor, it claimed, and warnings ambiguous, whilst the numbers of observations collected were far fewer than were needed. Amongst other recommendations, the report called for an investigation into the laws governing weather changes both at sea and on land and proposed the establishment of a new system of observatories and other weather stations to 'afford for the entire area of the United Kingdom accurate meteorological information'.[52] Furthermore, it was suggested that the department should be directed not by the government but by scientific institutions – the Royal Society and the Kew Observatory in fact. Robert Scott nominally replaced FitzRoy, although he in turn reported to the Meteorological Committee of the Royal Society and was supervised by Balfour Stewart at the Kew Observatory.[53]

The operations of the new committee were divided into three areas: ocean meteorology, telegraphy and weather signals, and land meteorology. To develop the last, it was recommended that a small number of technologically advanced observatories should be established, in turn complemented by a larger number of less sophisticated stations both on land and at sea. Following discussions at the 1873 Vienna Congress, a conference on intellectual property rights that was associated with the 1873 Vienna International Exposition, these sites were placed in one of three orders: first-order stations that would collect observations on a great scale, either hourly or continuously; those of a second order that provided 'complete and regular observations of the usual meteorological elements'; and those of a third order that could take only some of the measurements of a second-order station.[54] In the UK the committee's proposed observatories were ranked as first-order stations; stations operated by volunteers providing eye measurements twice daily were second-order; whilst anemographic, telegraphic stations and sundry other sites were classed as third-order.[55] Stations such as

50 Peter Nichols, *Evolution's Captain: The Dark Fate of the Man Who Sailed Charles Darwin around the World*, London, 2003.

51 Burton, op. cit. (37), 169. For a history of FitzRoy's involvement in the Meteorological Office see G. Simpson, 'FitzRoy and weather forecasts', *Meteorological Magazine* (1955), **84**, 167–73.

52 Anon., *Report of the Meteorological Committee of the Royal Society, for the Year ending 31st December 1870*, London, 1871, 6. See also Burton, op. cit. (37), 170.

53 For a short biography of Scott see J. Burton, 'Pen portraits of Presidents [of the Royal Meteorological Society] – Robert Henry Scott, MA, DSc, FRS', *Weather* (1994), **49**, 323–4.

54 R. H. Scott, *Instructions in the Use of Meteorological Instruments. Compiled by Direction of the Meteorological Committee*, London, 1875, 7.

55 Anon., *Annual Reports of the Meteorological Council to the Royal Society, for the Year ending 31st of March 1883*, London, 1884.

those operated by the RIC in Truro and by Matthew Moyle at Helston were recognized as second-order stations and their administration and inspection was shared by the Royal Society and the Royal Meteorological Society. Guidelines for observations at these and the third-order stations were laid out by Sir Henry James, director general of the Ordnance Survey, and later updated by Robert Scott in 1875.[56] Stations were inspected on a regular basis by either Meteorological Office or Royal Meteorological Society staff.[57]

Of the larger first-order observatories, eight were originally proposed but pressure from the Treasury meant that only seven were established, with the promise of some fifteen years' funding to maintain them, by which point, it was believed, sufficient data would have been collected materially to improve knowledge of weather patterns over the British Isles.[58] The seven observatories of the reconstituted Meteorological Office were spread across Britain and Ireland: two in Scotland, at the universities of Aberdeen and Glasgow (the proposed eighth would have been in Wick or Thurso in northern Scotland); two in Ireland, at the Armagh Observatory and on Valentia Island; and three in England, at Falmouth, Stonyhurst College in Lancashire, and Kew in London, the hub of the network.[59] Only the observatory at Valentia was set up, funded and staffed by the Meteorological Office itself; all the other sites were maintained by local scientific bodies. The Meteorological Committee considered the distribution of the sites to be 'as well distributed over the area of the British Isles as was compatible with the existence of an efficient local scientific superintendence'.[60] The seven observatories were to collect a wide range of meteorological data, and with the help of self-recording instruments would provide a wealth of information that would 'exhibit the changes in atmospheric conditions which pass over our islands with absolute fidelity, and will thereby throw a totally new light on the study of the weather',[61] and would be 'of the greatest importance to the advancement of Meteorological Science'[62] and thus also invaluable to the nation.[63] It is, though, important to note that these proclamations did conceal very real concerns in the late 1860s about how to turn continuous records into numerical results

56 Sir H. James, *Instructions for Taking Meteorological Observations*, London, 1861; Scott, op. cit. (54).

57 Anon., op. cit. (52).

58 Anon., *Annual Reports of the Meteorological Council to the Royal Society, for the Year ending 31st of December 1867*, London, 1868, 55–60. This report provides a detailed account of the correspondence between the Board of Trade (on behalf of the Royal Society) and the Treasury on the matter of finance for the observatories project.

59 K. Anderson, 'The weather prophets: science and reputation in Victorian meteorology', *History of Science* (1999), **37**, 179–216. Greenwich Observatory did serve as an informal eighth observatory.

60 Anon., op. cit. (58), 22.

61 Anon., *Report of the Meteorological Committee of the Royal Society, for the Year ending 31st December 1869*, London, 1870, 20; R. H. Scott, 'On the work of the Meteorological Office, past and present', *Weekly Meeting of the Royal Institution of Great Britain*, Pamphlet 19, Meteorological Office archive, Exeter, 30 April 1869.

62 Falmouth Meteorological Observatory, Untitled Pamphlet, *Royal Cornwall Polytechnic Society Minute Book 1873–1884*, RCPS archive, June 1883.

63 On science and improvement in Britain see R. H. Drayton, *Nature's Government: Science, Imperial Britain, and the 'Improvement' of the World*, New Haven, 2000; M. Bravo, 'Geographies of exploration and improvement: William Scoresby and arctic whaling (1782–1822)', *Journal of Historical Geography* (2006) **32**, 512–38.

useful to science and government.[64] As Figure 2 demonstrates, this new network of meteorological observation both determined a spatial hierarchy of meteorological sites in the British Isles and, with its close and careful system of supervision and regulation, the Committee believed, guaranteed an accurate picture of the nation's weather.[65]

The Falmouth Observatory

The RCPS was approached by the Royal Society to establish a first-order observatory at Falmouth. The society was delighted to be accorded this honour and in late January 1867 a meteorological committee was set up to oversee the establishment of the observatory.[66] After considering a number of existing sites, Balfour Stewart from the Kew Observatory eventually gave his approval to a parcel of land on Bowling Green Hill, high above the harbour.[67] It was decided that a new building should be built, a tower that would be 'sufficiently high above the houses to be exposed to the winds without interruption',[68] so that the anemometer should be kept free from eddies.[69] Given its prominent position above the harbour it was also proposed that a time-ball be mounted on the tower, for the benefit of townsfolk and sailors, although this appears never to have been erected. A range of other stipulations were laid down concerning the size and height of rooms, the number and aspects of windows, the positioning of instruments and so on. The building of the tower was commenced on 2 September 1867 and completed by the beginning of December of that year. Mr Lovell Squire's appointment as the first observer was approved and the government began to provide the society with an annual grant of £250 to cover its operation.[70] In July 1869, with an increase in the grant, Mr Kitto was appointed assistant observer to Squire. An assistant secretary was also appointed, partly paid for out of RCPS funds.[71]

In common with the other observatories, the Falmouth Observatory was fitted with a number of self-recording meteorological instruments: a Robinson anemometer (to record wind direction and velocity), a thermograph (to record air temperature and evaporation), and a barograph (to record air pressure).[72] A Beckley rain gauge was

64 See Anon., *Annual Reports of the Meteorological Council to the Royal Society, for the Year ending 31st of December 1868*, London, 1869, 22, which notes continuing discussions as to the conversion of continuous records into 'mean numerical results, at once satisfactory to science and practically useful to the public'.

65 A full list of stations was provided by the Meteorological Council in Anon., *Annual Reports of the Meteorological Council to the Royal Society, for the Year ending 31st of March 1880*, London, 1881, 20–3.

66 Anon., 'Annual committee meeting', *Cornwall Polytechnic Society Minute Book, No. 3, 1857–1873*, RCPS archives, 30 January 1867.

67 Anon., 'First meeting of the Meteorological Sub-Committee', *Cornwall Polytechnic Society Minute Book, No. 3, 1857–1873*, RCPS archives, 6 March 1867.

68 Anon., 'Second meeting of the Meteorological Sub-Committee', *Cornwall Polytechnic Society Minute Book, No. 3, 1857–1873*, RCPS archives, 3 April 1867.

69 Anon., 'Report of the Meteorological Sub-Committee', *Cornwall Polytechnic Society Minute Book, No. 3, 1857–1873*, RCPS archives, 26 April 1867.

70 Anon., 'Report of the Committee', *Report of the RCPS* (1868), p. xiii.

71 Anon., 'Report of the Meteorological Committee', *Cornwall Polytechnic Society Minute Book, No. 3, 1857–73*, RCPS archives, 18 January 1870.

72 Falmouth Meteorological Observatory, op. cit. (62).

Figure 2. Map of stations associated with the Meteorological Office (from the *Annual Reports of the Meteorological Council*, London, 1881).

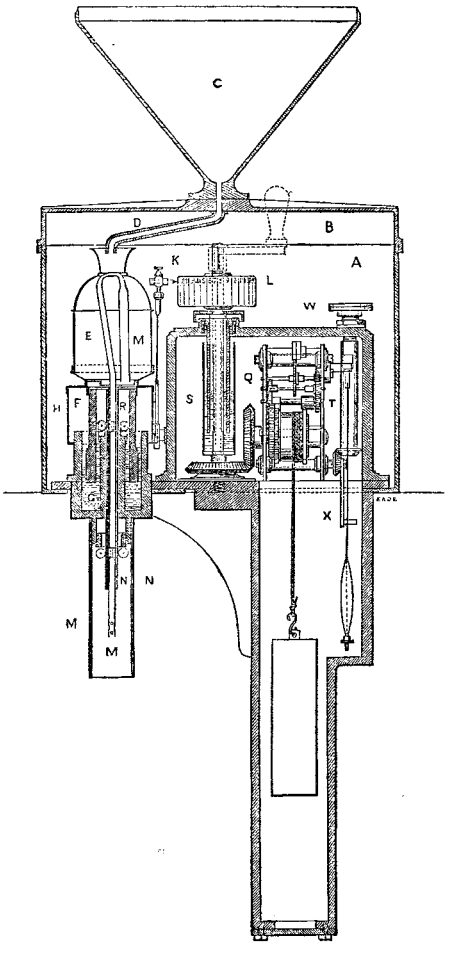


Figure 3. The Beckley rain gauge (from Anon., 'Description of a self-recording rain gauge', *Report of the RCPS* (1869), 44).

added in April 1871 and a bright-sunshine recorder in March 1880, their additions to the observatory important enough to warrant articles on each of them in the *Reports* of the Society (Figure 3).[73] The ownership and employment of these novel instruments placed the observatory and the society at the forefront of meteorological science and promised 'mechanized records of phenomena secured from the vagaries of the

73 See Anon., 'Description of a self-recording rain-gauge, invented by Robert Beckley, of the Kew Observatory; made by James Hicks, London', *Report of the RCPS* (1869), 43–7; Anon., 'The sunshine recorder', *Report of the RCPS* (1880), 73–5. A history of the origin, development and use of self-recording instruments was also provided by the Meteorological Committee of the Royal Society: Anon., 'A description of the self-recording instruments recently erected by the Meteorological Committee of the Royal Society in various parts of the United Kingdom', *Report of the Meteorological Committee of the Royal Society, for the Year Ending 31st December 1867*, London, 1868, 27–54.

human observer'.[74] That said, a number of standard instruments were still used, supplying additional meteorological information and acting as checks for the automated records.

Despite the promise of an observatory free from human intervention, the observer and his assistant were certainly kept busy; indeed the duties and actions of the two staff were minutely prescribed in the regulations of the observatory and regulated by the Meteorological Committee of the RCPS and the Meteorological Office.[75] A barometer and dry- and wet-bulb thermometers were to be read five times daily – at 10 a.m., 2 p.m., 4 p.m., 6 p.m. and 10 p.m. – and general weather observations taken, whilst a mercurial maximum thermometer and a spirit minimum thermometer were read once every twenty-four hours, at 10 p.m.[76] At 9.30 a.m. all clocks and the chronometer were to be wound, at 10 a.m. the rain gauge cylinder was to be replaced (and the rain in the copper gauge to be measured to 0.005 of an inch), at 10.30 a.m. the anemograph sheet was to be replaced, and between 10 and 11 a.m. on alternate mornings the barograph and thermograph sheets were to be changed and photographs to be developed and fixed straight away. Preparation of tabulations of anemograph, thermograph, wind and rain curves were to occupy the attentions of the observer when not dealing with the instruments. In addition, on Tuesdays the observer was to trace on a printed form the sun cards and to prepare the weekly weather register; on Thursdays a full examination of all registers, tabulations and curves for the preceding week was to take place; and at regular intervals instruments were to be cleaned and oiled, water filtered and distilled, cotton threads and muslins to be replaced and baths and solutions to be prepared. Lastly, reports were to be prepared and sent every Tuesday and Thursday to the Meteorological Office, and weekly, monthly and annual weather tables drawn up for publication: the *Western Morning News*, the *Western Daily Mercury* and the Falmouth *News Slip* published tables weekly, while the *Western Chronicle of Science* did so on a monthly basis; the *Reports* of the RCPS published yearly summaries of the records.[77]

All of this was in conformity with the regulations laid down by the Meteorological Committee of the Royal Society as printed in an appendix to their annual reports in 1869.[78] Not only did this lay out the procedures for the collection of information of the instruments, it also detailed the process for the registration of any 'deficiencies and mistakes in the returns', copies of which were to be presented not only to the director of the observatory in question, but also to the Meteorological Office itself.[79] George Whipple, the council's observatories inspector, paid yearly visits that were also

74 K. Anderson, 'Looking at the sky: the visual context of Victorian meteorology', *BJHS* (2003), **36**, 301–32, 302.

75 The required duties and activities of the observatory's staff were published in W. L. Fox, 'Report of the Meteorological Committee for the year 1883', *Reports of the RCPS* (1883), 121–6.

76 Falmouth Meteorological Observatory, op. cit. (62).

77 Anon., 'Report of the Committee. 9th February 1871', *Reports of the RCPS* (1871), 13.

78 Anon., 'Code of regulation adopted by the Meteorological Committee for ensuring accuracy in the results derived from their self-recording instruments', *Report of the Meteorological Committee of the Royal Society, for the Year ending 31st December 1868*, London, 1869, 62–72.

79 Anon., op. cit. (78), 62.

designed to detect human and instrumental shortcomings. Although his reports were generally favourable towards the Falmouth Observatory he nonetheless noted numerous minor problems: in 1880 he noted that the velocity pencil of the anemograph did not mark properly and that the sunshine recorder card was slightly out of focus, in 1882 he noted the need to re-blacken the wet-bulb thermometer and tighten the fan of the anemograph, and in 1885 he noted the fixing of the rain gauge's pencil.

The exacting regime that the Meteorological Committee of the RCPS imposed on the observatory and its staff and instruments, and that imposed in turn on the RCPS by the Meteorological Committee of the Royal Society, were aimed at producing weather data of an unprecedented precision, regularity and accuracy. This was meant to be data that mirrored exactly the weather experienced by the observatory over the course of the day, week, month and year, and yet to be also free from the idiosyncrasies of previous provincial weather-collecting. However, to the embarrassment of the RCPS and the frustration of the Royal Society, the production of national weather at Falmouth was not always realized. For instance, the observatory had problems securing and positioning equipment – the self-recording rain gauge was promised in 1869, and when it finally arrived in 1871 the Meteorological Committee were unsure where best to place it. It ended up in the back garden of Mr W. P. Dymond when no suitable place at the observatory was found.[80] Even equipment that was housed in the purpose-built observatory posed problems. The committee reported difficulties with its photographic results in 1868, which they put down to 'the dampness of the building, and to the want of proper ventilation'. Happily, 'the high temperature of the past summer, and better arrangements for ventilating the rooms' improved the images. Meanwhile, gales damaged the anemometer and so interrupted the wind record.[81] Clearly, Cornwall's national weather carried some very local inflections.

It was perhaps understandable that new equipment and a new building would pose some impediments to the smooth progress of the Falmouth Observatory and that the weather at times would cause its own problems (although it was more unexpected that an unseasonably hot summer would actually improve the running of particular equipment). The observatory staff itself, through discerning appointments and careful policing, was surely one thing the RCPS felt it could control. However, there too they struggled. In January 1870 the Meteorological Committee reported 'a serious discrepancy' between the General Committee and Mr Squire in regard to the terms of Squire's contract and particularly to his claims on the government grant for the maintenance of the Observatory.[82] Whilst the RCPS saw Squire as under their employ and so 'accountable to them for the proper management of the Observatory', Squire argued that, as observer, he was effectively a government employee and the grant his to do with as he wished. Squire also protested at the appointment of an assistant observer and secretary. The RCPS quickly rewrote Squire's contract.

In January 1882 Squire tried again to adjust arrangements at the Observatory to his own benefit, requesting that his son help him there. Furthermore, he suggested that his

80 Anon., op. cit. (77), 13.
81 Anon., op. cit. (70), p. xiii.
82 Anon., op. cit. (71).

son and family should move into the observatory, claiming that climbing the stairs of the tower was affecting his health. Mr Kitto, the assistant observer, in turn complained, worrying that Squire's son would effectively become superintendent, a post he was first in line for, having worked there for fourteen years.[83] Upon the rejection of his request Squire promptly resigned his post and Kitto was duly appointed superintendent observer. Whilst the committee looked for an assistant – the job was eventually given to Mr Frederick Skinner – Kitto was asked to train his wife to help him perform his duties.[84]

Here then were a number of instrumental and personnel problems that reminded the Meteorological Office that, despite the hubris of the age, measurement could fail. It was also a reminder that people could occasionally resist the exacting requirements of measurement techniques along with the intellectual, economic, political and moral demands into which they had been enrolled.[85]

The rise and fall … and rise of the Falmouth Observatory

Despite these problems, the RCPS had every reason to be satisfied with the progress of its observatory. Upon visiting Falmouth in 1879, Robert Scott reported that the Royal Society considered all in order with its southernmost observatory. As it cemented its position at the centre of the region's meteorological endeavours the observatory began to expand its enterprises into the surrounding area. From 1871 sea temperatures were taken off the coast of Falmouth by W. P. Dymond, following instructions laid out by the Meteorological Committee of the Royal Society.[86] Further observations were made at the eastern breakwater of the Falmouth docks from September 1882, with the aid of the Falmouth Docks Company.[87] This association built on the claim that meteorological science had great value to local industry – in this case to Falmouth's fishing fleet.

Other stations were established on land. At Helston dry- and wet-bulb and maximum and minimum thermometers, a Stevenson's thermometer screen and a rain gauge were fixed in a meadow at the rear of Mr Gill's house and a standard barometer was subsequently added. Gill, replacing the late Dr Moyle, began taking twice-daily observations for the society from June 1881, the results of which were forwarded to the RCPS, the Meteorological Office and the Meteorological Society on a monthly basis.[88] A climatological station similar to that at Helston was established in the same year at 8 Florence Terrace, Falmouth and operated by Wilson Fox, the RCPS's honorary

83 Anon., 'Meeting of the Meteorological Sub-Committee', *Cornwall Polytechnic Society Minute Book, No. 3, 1857–1873*, RCPS archives, 18 January 1882.

84 Anon., 'Meeting of the Meteorological Sub-Committee', *Cornwall Polytechnic Society Minute Book, No. 3, 1857–1873*, RCPS archives, 26 January 1882; W. L. Fox, 'Report of the Meteorological Sub-Committee for the Year 1882', *Reports of the RCPS* (1882), 15–16.

85 Barry, op. cit. (4), 468.

86 W. P. Dymond, 'Meteorological notes', *Reports of the RCPS* (1874), 1–8.

87 W. L. Fox, 'Report of the Meteorological Sub-Committee for the Year 1882', *Reports of the RCPS* (1882), 15–16.

88 'Meeting of the Meteorological Committee', *Cornwall Polytechnic Society Minute Book, 1873–84*, RCPS archives, 6 August 1881.

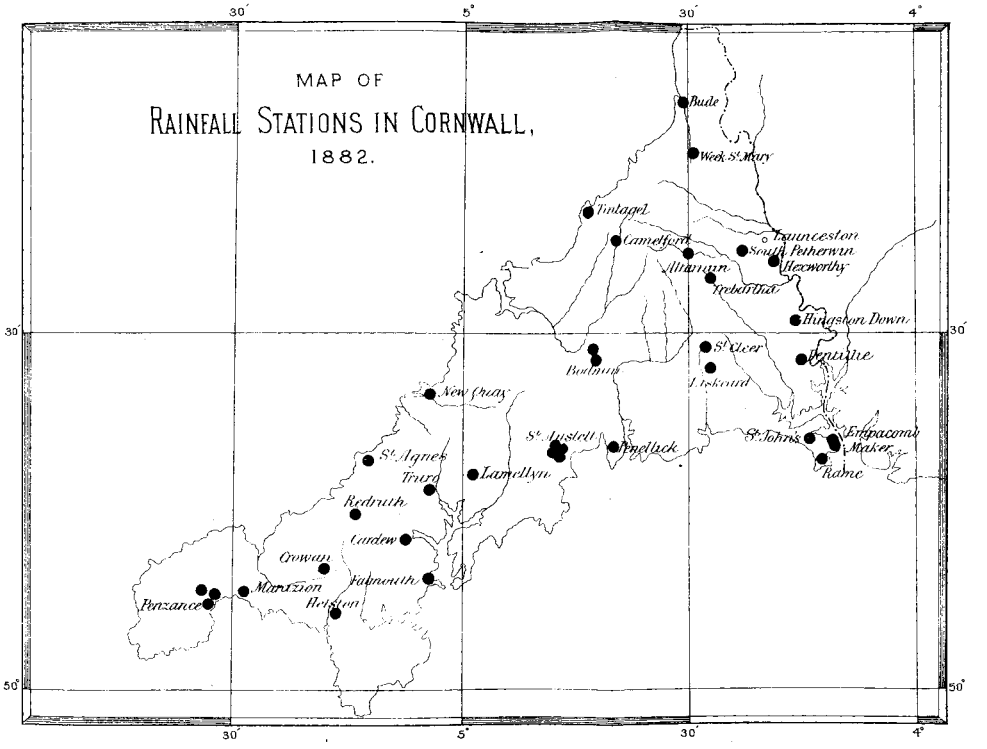


Figure 4. Symons's map of rainfall stations in Cornwall (from G. J. Symons, 'On rainfall in Cornwall', *Reports of the RCPS* (1882), 129–33).

meteorological secretary. Both these stations were inspected by William Marriott, the assistant secretary of the Meteorological Society, in July 1882 and declared satisfactory.[89] Other schemes were planned although they were not realized – a system of tide registrations at Falmouth using self-registering tide gauges, and a climatological station at Flushing, across the harbour from Falmouth. The numerous successes of the Falmouth Observatory and of Cornish meteorology more generally were duly celebrated during the RCPS's jubilee year in 1882 and prominent national meteorologists visited Falmouth, most notably George Whipple, who spoke at a conference organized by the Polytechnic Society in September of that year.[90] George James Symons, editor of *Symon's Monthly Meteorological Magazine*, also presented a paper, on rainfall distribution in Cornwall (see Figure 4).[91]

89 W. L. Fox, op. cit. (87), 16.

90 Whipple's paper was subsequently published by the society: G. M. Whipple, 'Meteorology, or weather knowledge: its progress and modern aspects', *Reports of the RCPS* (1882), 147–53.

91 G. J. Symons, 'On rainfall in Cornwall', *Reports of the RCPS* (1882), 129–33. Symons was a nationally renowned expert on rainfall. For a history of Symons's work in this area see D. E. Pedgley, *A Short History of the British Rainfall Organization*, Occasional Papers on Meteorological History No. 5, Reading, 2002.

Given its increasing level of influence and prominence in meteorological science, the RCPS was understandably taken aback by the Royal Society's announcement in February 1883, only six months after their jubilee conference, that they intended to withdraw financial support for the observatory. With the reconstitution in 1877 of the Meteorological Committee, which became the Meteorological Council, a review of meteorological data collection was ordered. The report of the treasury committee remarked that

> Doubts have … been expressed whether, in the present state of meteorological science, the minute exactness of the observations now taken at these stations is of sufficient comparative value to justify the whole of the costs which they involve, when there are so many other objects of meteorological inquiry which call for increased expenditure.[92]

Opinions were sought from several of Europe's most eminent meteorologists and upon their recommendations the council decided to close all but three of its seven first-order stations, in line with their originally stated aim of financing the programme for only fifteen years. The money saved was to facilitate better analysis of the continuous records already obtained, to finance synoptic and experimental studies of weather and to provide more complete equipment to those observatories to be kept in operation.[93] The three stations that would retain the council's patronage were Kew, Valentia and Aberdeen, thus 'forming a nearly equilateral triangle which covers a great part of the United Kingdom'.[94] Kew was essential to the testing of new instruments and methods of observation, Valentia was deemed the most important station in terms of weather forecasting and Aberdeen was a valuable site for the monitoring of Britain's northerly climate. The council hesitated over the fate of the Falmouth Observatory, 'on account of its undeniably good geographical position'. However, upon the advice of Dr Robert Mann, a previous president of the Meteorological Society (from 1873 to 1875), it was decided that the observatory was unsuitable for further observation due to its 'confined site'.[95] Mann, an expert on astronomy and photography as well as meteorology, claimed in his evidence to the committee that at Falmouth

> the observatory stands upon an accidentally selected spot, where a small street occupies the uniting line between two high ridges in a cul de sac. The temperature observations taken there are not comparable, certainly with those of observatories that are more fairly placed.
>
> … (*Chairman.*) Do I understand you that the observatory at Falmouth is so placed as to be under very peculiar meteorological conditions? – Yes, under local conditions which do not give good general results.[96]

92 R. H. Scott, 'Minute explanatory of the reasons for which the Meteorological Council have resolved to close some of their self-recording observatories', *Annual Reports of the Meteorological Council to the Royal Society, for the Year ending 31st of March 1884*, London, 1885, 91–2. It was reprinted in the minutes of the *Cornwall Polytechnic Society Minute Book, 1873–84*, RCPS archives.

93 The council sought the opinions of Dr Hann, the director of the Vienna Meteorological Observatory; Dr Wild, the head of the Meteorological Service in Russia; and Mr H. S. Eaton, a past president of the Meteorological Society of London.

94 Scott, op. cit. (92), 93.

95 For a short biography of Mann see M. Walker, 'Pen portraits of presidents [of the Royal Meteorological Society] – Robert James Mann, MD', *Weather* (2001), **56**, 8–11.

96 Extract from the Report of the Treasury Committee, 1877, 88, quoted in Scott, op. cit. (92), 95.

This complaint was not entirely unfamiliar. In 1868 the Meteorological Committee had in fact raised concerns about the 'local situation' of their observatories and the ability to relate records from one to the other, for instance highlighting the very different anemographic results from Falmouth and Valentia as compared to those from Kew and Stonyhurst.[97] However, despite Mann's damning remarks as to the Falmouth Observatory's very local and un-national characteristics, the council nonetheless continued to forestall on its commitment to withdraw its support for an observatory in west Cornwall, offering at the very least the possibility of a second-class observatory at Land's End in connection with the telegraph station and the continued maintenance of a barograph at Falmouth. The other observatories were left in similar and just as precarious situations: Armagh was to be maintained as a second-order station and Stonyhurst to be run by the college authorities, and it was hoped that the Glasgow observatory would be kept up through local funds.[98]

The RCPS were unhappy with the demotion of their station and wanted no less than the continuation of a first-order observatory at Falmouth. The importance of the observatory as the standard for a regional meteorological culture was pointed out. Mr Robert Fox argued that the observatory should not be allowed to close because it 'was for the benefit of the county at large'.[99] In an open letter to the Meteorological Committee of the Royal Society the RCPS claimed that the observatory acted as an important node for other activities in the region, forming 'a standard for private observers throughout the county and beyond its borders'.[100] The closure of the station, contended John Couch Adams, Lowndean professor of astronomy and geometry at Cambridge and director of the Cambridge Observatory, would be 'a heavy blow to the cultivation of Meteorological science in Cornwall and the West of England generally, where there are many local stations which regard Falmouth as their scientific centre'.[101]

Adams and others also asserted the observatory's paramount significance in the development of meteorological science at a national level. The Meteorological Committee of the RCPS argued that Falmouth's location in the far south-west of England made it invaluable for tracing the course of storms advancing on the UK from the south (and they were quick to point out that the station at Valentia was often too far north to experience these). This information was useful to a number of parties, including the Board of Trade, the Admiralty Courts in London, others using the English Channel and those who needed meteorological data for 'scientific inquiry'.[102] In terms of 'scientific

97 Anon., op. cit. (64), 21.

98 Anon., *Annual Reports of the Meteorological Council to the Royal Society, for the Year ending 31st of March 1884*, London, 1885.

99 Anon., 'Report of the Committee', *Reports of the RCPS* (1884), 2.

100 A lengthy extract from the letter is printed in the Reports of the society, in Anon., 'The Falmouth observatory', *Reports of the RCPS* (1885), 103–4. A draft of the full letter is in Anon., 'Meeting of the General Committee, 4 April 1883', *Cornwall Polytechnic Society Minute Book, 1873–84*, RCPS archives.

101 Adams, a Cornishman by birth, was persuaded to write his letter supporting the case to the Royal Society, and his letter to them was reprinted in the reports of the society: Anon., 'The Falmouth observatory', op. cit. (100), 106–9.

102 Anon., 'Meeting of the General Committee, 4 April 1883', *Cornwall Polytechnic Society Minute Book, 1873–1884*, RCPS archives.

inquiry' the society pointed out that the observatory was the only station in Cornwall with a bright-sunshine recorder and that its self-recording rain gauge was the only one in the west of England. By association, Adams warned of the dangers of assuming that enough data had been collected since the seven first-order observatories had been established to enable the generation of general laws of the weather, asserting instead that regular records became more useful the longer they were collected.

The council of the RCPS took these arguments, along with the backing for them expressed by MPs, prominent scientific figures and local dignitaries, to the Meteorological Council. On 27 June 1883 a deputation, led by the Rt. Hon. the Earl of Mount Edgecumbe, met with the Meteorological Council and pressed its case. Further support was garnered from the BAAS and lobbying continued throughout the year. Even Thomas Huxley was persuaded to give his support. By November the Meteorological Council relented, offering in a letter dated 24 November 1883 to continue their annual grant of £250 to the RCPS – guaranteed for five years – and to allow the use of their instruments, if a new observatory were built that would 'enable the records to be made under thoroughly satisfactory conditions'.[103] Further petitioning resulted in a grant of £300 from the Royal Society towards the cost of the new building.[104]

Touching the fringe of science

The society moved quickly to secure a site for Falmouth's new observatory. In consultation with the Royal Society a location was chosen somewhat to the west of the original tower. The laying of the new observatory's foundation stone on 12 August 1884 was a very public ceremony, with a large number of prominent local figures in attendance. A number of speeches were given and a band from the HMS *Ganges* played music during the intervals. That the new observatory conferred distinction on the town and the county was evidenced in those people who publicly paid tribute to the venture, amongst others the high sheriff of Cornwall, the archdeacon of Cornwall and local MPs and prominent scientists, including the renowned archaeologist William Pengelly. The event was widely covered in the local press and was an expression of a very civic science.[105] The new observatory would, it was claimed, bring the moral benefits of science to the local people; in his speech to the crowd, Mr T. Bedford Bolitho, the high sheriff, claimed that 'English people, although eminently devoted to matters of a practical nature, loved to touch the fringe of science in some way or other, and it appeared to him that this Observatory was destined to be a link between science and

103 Anon., untitled entry dated 29 November 1883, *Minute Book of the Meteorological Committee, 1882–94*, RCPS archives, 34.

104 G. G. Stokes, letter to the RCPS from the Royal Society, dated 31 December 1883, *Minute Book of the Meteorological Committee, 1882–94*, RCPS archives, 48. This letter stipulated conditions on the grant and the yearly stipend: that all instruments would be the property of the Royal Society, for instance, and that the RCPS would be obliged to furnish the Society with regular statements of expenditure, receipts and results collected.

105 On the production of local civic science see D. Finnegan, 'Natural history societies in late Victorian Scotland and the pursuit of local civic science', *BJHS* (2005), **38**, 53–72.

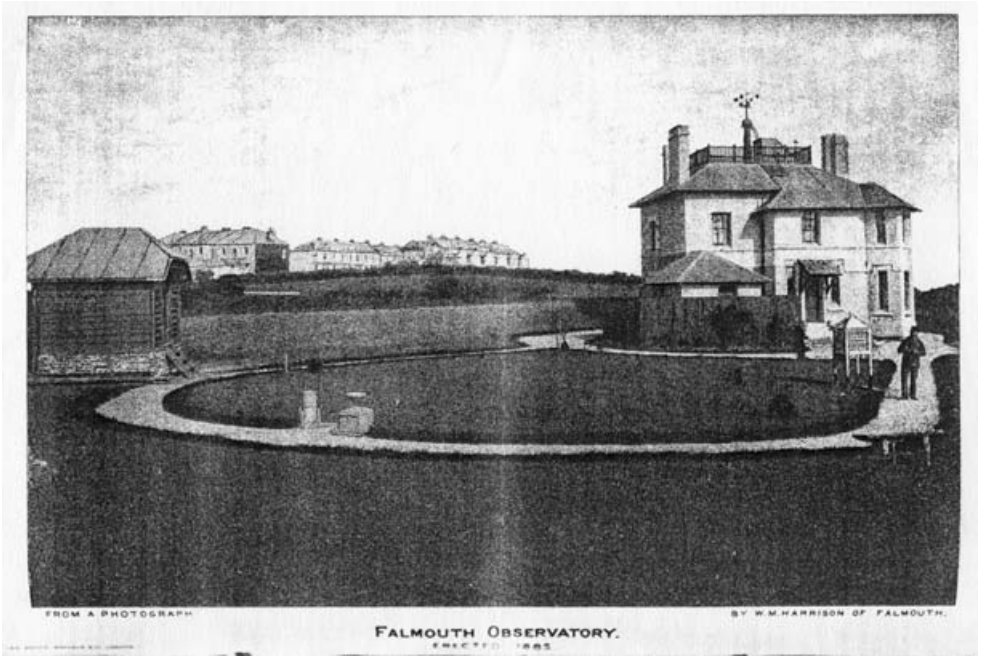


Figure 5. The second Falmouth Observatory (frontispiece to *The Fifty-Third Annual Report of the RCPS*, Falmouth, 1885).

practice'.[106] The project was indeed widely supported through public donations; a significant amount was collected at the foundation-stone celebration. By 31 December 1884 £668 of the total amount of £1300 had been raised.[107]

The resulting building, approved by Whipple at Kew, was a detached villa in the Queen Anne style, with seven private rooms and seven for observations. It took nine months to erect but eventually the various instruments were stopped at the old observatory and, after some preliminary work, started again on the morning of 9 May 1885 at the new site (Figure 5). The observer took up residence on 14 May. The building's latitude and longitude were supplied by the Ordnance Office at Southampton and the observatory followed the time at Falmouth Post Office, which was in turn confirmed by the telegraph daily at 10 a.m.

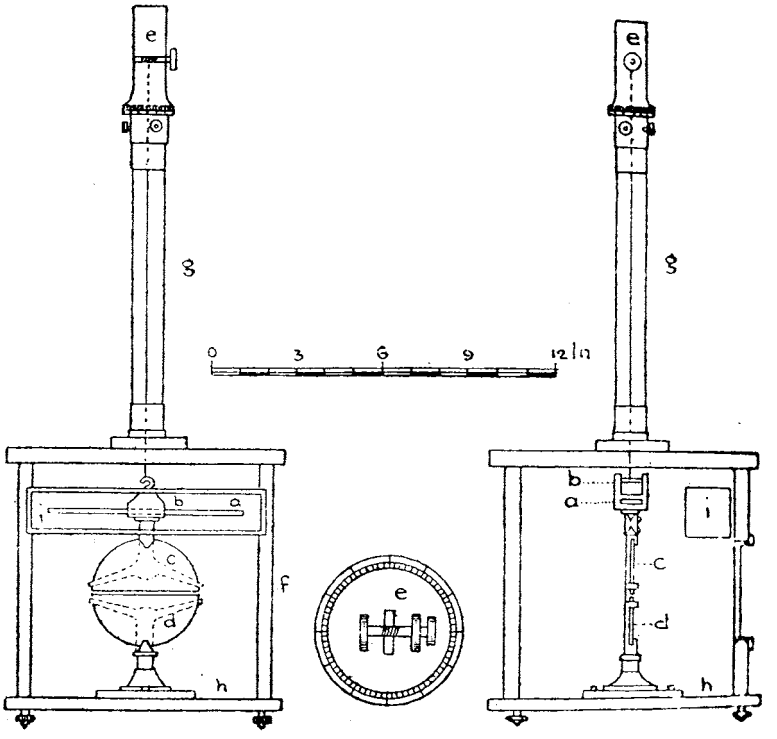
The new observatory differed in a number of ways from the old. The grounds in which the new building sat were much more extensive, and so enabled the location of instruments near the observatory rather than in a private garden. New photographic methods were employed that produced a 'much greater rapidity, brilliancy, and sharpness of definition',[108] and the anemometer was fixed to an iron column set on a flat

106 Anon., 'Laying the foundation stone of the new observatory', *Reports of the RCPS* (1884), 34.

107 A full list of donors is provided in the *Reports of the RCPS* (1885), 89–95.

108 Anon., article on the new observatory published in the *Western Morning News* and pasted into the Minute Book, 30 June 1885, *Minute Book of the Meteorological Committee, 1882–1894*, RCPS archives, 63.

FIG. 1. *Declination Magnetometer.*



1. DECLINATION MAGNETOMETER, FIG. 1.

The different parts of this instrument are

a. Magnet.
b. Stirrup.
c. Mirror.
d. Fixed Mirror.
e. Suspension Piece.
f. Case.
g. Suspension Tube.
h. Base.
i. Damper.

Figure 6. The declination magnetograph (from Anon., 'Falmouth observatory magnetographs', *Reports of the RCPS* (1886), 196).

leaded roof that was deemed a great improvement on the wooden staging of the old site. New instruments were also located at the observatory. Of particular note was a set of magnetographs for recording the variations in the earth's magnetic field (Figure 6). This was strictly separate from the work of the Meteorological Office but was nonetheless

funded by the Royal Society. A separate absolute magnetic house was erected in the grounds of the observatory and the instruments installed by Kew's magnetic observer, Mr T. W. Baker. Much was made of the new instruments in the *Reports* of the RCPS.[109]

The establishment of the new observatory at Falmouth was a major triumph for the RCPS and for the Cornish scientific community more generally. The observatory performed well enough from its opening for Whipple to claim, upon a visit in August 1889, that he 'considered the Falmouth Observatory both as regards its location and the position of the various instruments the best of any under the Meteorological Office', and that he 'looked upon it as a model Meteorological Station'.[110] In late October of that year the remaining debt against the cost of the building was paid off. The station continued to pass the Royal Society's regular inspections, although it remained plagued with problems: damage to equipment, the flooding of the subterranean magnetic house on several occasions, problems with the new photographic equipment in 1885, the loss of sunshine cards in 1887, serious discrepancies in rain gauge measurements in 1888 and in the tabulation of wet-bulb tabulation records in 1890, and the mysterious disappearance of the assistant observer that same year. The RCPS's climatological station at Helston was eventually discontinued. Gill had been complaining of illness and 'overpressure' since 1886 and the station's records were so sporadic that the RCPS decided to close it in 1888.[111] The Falmouth Observatory continued to operate as a meteorological station until the 1950s. Whilst the Meteorological Council eventually withdrew their support in 1921, the Falmouth Town Council took over in support of the RCPS. However, on 14 May 1953 the observatory formally closed and became instead a 'health resort station', although this did include the recording of meteorological information.[112]

Conclusions

Through sites like Falmouth's observatory, national institutions with a meteorological remit – the Meteorological Office, the BAAS and its Kew Observatory, the Royal Society and the BMS – extended their influence over a national space. As we have seen, this was achieved through the extension of sophisticated meteorological instruments to various stations, the enforcement of standardized methods of measurement and the quantification of observations, and the disciplining of the actions of the observatories' staff. Despite the objections raised by the likes of John Couch Adams, the

109 For a full account of the establishment of the magnetic house see H. M. Jeffery, 'Report of the Meteorological Committee on the establishment of the magnetograph instruments at Falmouth observatory', *Reports of the RCPS* (1886), 16–19. A description of the instruments was also given in Anon., 'Falmouth observatory magnetographs', *Reports of the RCPS* (1886), 195–206.

110 Mr G. M. Whipple, quoted in the minutes of the Meteorological Committee, 21 October 1889, *Minute Book of the Meteorological Committee, 1882–94*, RCPS archives, 139.

111 Anon., Minutes of a Committee Meeting, 11 December 1886, *Minute Book of the Meteorological Committee, 1882–94*, RCPS archives; Anon., Minutes, 31 July 1888, *Minute Book of the Meteorological Committee, 1882–94*, RCPS archives.

112 Anon., *Brief History of Relationships between the Meteorological Office and the Royal Cornwall Polytechnic Society*, Meteorological Office Archives, Exeter, undated.

Meteorological Office was happy to continue this policy through the management of only a very few, albeit technologically advanced, sites of observation, in turn controlled by one site, Kew, where instruments and practices were invented and calibrated. In the generation of general theories of British weather systems fewer was definitely better. This attitude was indicative of nineteenth-century meteorology, as it 'worked to replace the place-centred and curiosity-driven authority of meteoric reportage by an indoor computation of atmospheric ''tides'' and storm paths'.[113] The observations of stations like Falmouth mattered only in terms of the experimental and modelling studies they facilitated. While local weather was an important prerequisite for a knowledge of globally evolving systems, 'scrutiny of local weather … mattered only to the extent to which the atmosphere could manifest itself in a place'.[114] Understood in this way, Cornish meteorology in the mid- to late nineteenth century no longer mattered for its own sake; it was important only for the contributions it could make to understandings of processes operating on a much bigger canvas. The progressive reduction in the number of government-financed first-order observatories only goes to illustrate this point. Whilst the Meteorological Council of the Royal Society certainly encouraged the continued operations of the demoted first-order stations like Armagh, Stonyhurst and Glasgow, its priorities clearly shifted away from a place-bound collecting culture – even where those places were regulated to an unprecedented degree – to a laboratory culture that had little time for what Janković has referred to as an 'ethos of locality'.[115]

This is of course only part of the story. While the history of British meteorology was assuredly one of increasing centralization, institutionalization and marginalization of provincial contributions, its historical geography was rather more complex. The development of a national network of weather stations was clearly not as straightforward as the above account might suggest. Sophisticated instruments, calibrated at Kew, still had to be assimilated and interpreted in particular local contexts; the ideals of the Kew meteorologists routinely compromised by the vagaries of local geography, social norms and politics. At Falmouth, anemographs blew off the roof, photographs got damp, buildings were flooded, and the siting of the rain gauge was compromised by lack of space. Meanwhile, readings that were taken were at times thrown into doubt by a failure to follow the standards set by Kew – readings were not taken properly and were occasionally lost, whilst observers resigned, retired or simply disappeared altogether.

The ubiquitous and objective did not only become local and subjective in a negative or problematic sense. The establishment of a national meteorological observatory in Falmouth served other more positive ends. Individuals made use of the observatory to further their careers, or to provide an income and even a home for their families. The station was also employed to facilitate the scientific ambitions of the RCPS and to engender a broader sense of civic pride in the town and the county. It was even implicated in the development of the regional agricultural, fishing and tourist economies.

113 Janković, op. cit. (18), 164.
114 Janković, op. cit. (18), 167.
115 Janković, op. cit. (18), 167.

Telling the story of the quantification, 'laboratorization' and nationalization of British meteorology from the perspective of a provincial station rather than from the meteorological metropole opens a new vista onto the history of the weather. At the very least it requires us to reconsider how we evaluate the relative significance of, and the relationships between, the provinces and the metropole.[116] It is undeniably the case that the Meteorological Council of the Royal Society was in a position of power over the Cornish scientists working in Falmouth, Helston, Truro and elsewhere. That said, what the RCPS achieved in mobilizing scientific and political allies and so saving their observatory in 1883 should remind us that this geography of power was negotiated and relational and certainly not predetermined or fixed. Put another way, we should treat nineteenth-century British meteorology not as an inevitable march towards a standardized national weather but as a set of practices that extended unevenly across a physical landscape, that actively constructed geographies of centre and periphery, and that relied on a set of social and intellectual relations that could at times produce outcomes contrary to the wishes of those who imagined themselves central to Britain's Victorian weather network.

116 For further discussions on this theme see Lewis Pyenson, 'An end to national science: the meaning and the extension of local knowledge', *History of Science* (2002), **40**, 251–90; Ian Inkster and Jack Morrell (eds.), *Metropolis and Province: Science in British Culture, 1780–1850*, Philadelphia, 1983.